THE WATER SUPPLY PROBLEM OF OUR STATE INSTITUTIONS[1]

By F. J. Postel

A brief outline of the administrative organization of the Illinois state government, as now constituted under the civil administrative code, will give a good idea of the nature of the work referred to the Department of Public Works and Buildings and the organization available for solving the problem. Attention is called to the similarity of the plan of organization to that of a large manufacturing industry.

The head of the Illinois state government is the governor. Under him are the nine department heads, known as directors, each in charge of one department. They are: director of finance, director of public works and buildings, director of public welfare, director of registration and education, director of agriculture, director of public health, director of labor, director of mines and minerals, and director of trade and commerce. Each of these departments is further sub-divided into divisions, the number depending on the number of sub-divisions most convenient for handling the business of the department. Thus, for example, the Department of Public Works and Buildings has seven divisions as follows: division of highways, division of waterways, division of printing, division of parks, division of purchases and supplies, division of supervising architect, and division of supervising engineer. The directors and heads of divisions are appointed by the governor. Their employes are all under civil service.

In a comparison with a large manufacturing industry, we then have the governor, comparable to the president and general manager; the directors, to the department heads of the business; and the division heads to the superintendents of the departments. Formerly, when the business of the state was split up among a large number of boards and commissions, each acting independently of the others, each could, and often did, do its own purchasing, hire its own

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attorneys, engineers, architects and other professional advisors. It is impossible to imagine a large manufacturing industry permitting each department head to have his own purchasing agent, his own lawyer, engineer and architect and to work independently of all the other departments.

If a department or division head needs supplies, a requisition is sent through the regular channels and lands in one of the four following places: (1) If it involves printing, it goes to the superintendent of printing. (2) If it involves engineering construction it goes to the supervising engineer. (3) If it involves architectural construction it goes to the supervising architect. (4) If it involves general supplies it goes to the division of purchases and supplies.

These divisions make the purchases, but they in turn may call upon any other division or department for assistance and advice.

For example, if the department of public welfare is in the market for blooded cattle for its farms, the division of purchases and supplies will call upon the division of animal industry of the department of agriculture for assistance in making the purchase. If the division of purchases and supplies needs data pertaining to coal, it calls upon the department of mines and minerals. If any department or division needs assistance in road construction, it calls upon the division of highways. If any department or division needs help in matters pertaining to heat, light, power, water, sewers, or similar matters, they call on the division of supervising engineer, which in turn may call upon the division of water survey or the department of health to work with it on the problem. The engineering division provides the means of supplying the water, but the division of water survey or the division of sanitation passes on the quality of the water. Briefly summarized then, the plan is to have each division specialize in some one branch of the state business, and then have all matters relating to that branch referred to that division.

With this outline of the organization, the manner in which this plan works out in the management of the state institutions may be explained as follows:

The welfare department has supervision over twelve hospitals for the insane and feeble minded, two penitentiaries, one reformatory, two correctional schools, three schools or homes for deaf and blind and three homes for soldiers and sailors, soldiers' orphans, and soldiers' widows. The department of registration and education operates five normal schools. The University of Illinois is not

included in this, as it does not come under the Civil Administrative Code.

In the operation of these institutions, the departments of public welfare and of registration and education occupy essentially the position of tenant, while the department of public works and buildings occupies the position of landlord. The landlord in this case, however, furnishes not only the buildings, but also all supplies, including food, clothing, equipment, heat, light and water. Under this plan of organization, it follows that the details pertaining to the supply of heat, light and water and similar service are under the supervising engineer. Under the plan of organization as it is now carried out, the design, construction, maintenance and operation of the mechanical equipment are treated strictly as engineering problems and worked out from an engineering standpoint, except, of course, for the one drawback which seems to exist everywhere, lack of funds.

Most institutions are located outside the corporate limits of cities so that, in general, they must provide their own source of water supply. We have in these institutions examples of practically every source of supply, including rivers, natural ponds, artificial ponds, deep wells and shallow wells and even springs. One institution, the Southern Illinois penitentiary at Chester, has three entirely separate sources of supply, the Mississippi River, an artificial lake in the hills back of the institution, and a large spring. The pumping equipment likewise represents practically every type used in plants of similar size.

When it is considered that the population of most of the institutions operated by the welfare department is from 1000 to 4000 and that these people live within the institution year in and year out, it will be realized that the problem of water supply for such an institution is very similar to that of a small town, except that the system covers a smaller area.

Unfortunately, few institutions are supplied with meters and in order to arrive at even an estimate of the water consumption per capita, it is necessary to use available data, some of which are perhaps not entirely reliable. Nevertheless, supplementing these with tests from time to time, it has been found that the water consumption per capita for the welfare institutions varies from about 70 to 350 gallons per capita per day. The 70-gallon institution was on a meter basis, while the institutions with a larger consumption,

as a rule, pumped their own supply. The author has been told at some of these institutions which pump their own supplies, that "our water costs us nothing as we pump it from our own wells." As a matter of fact, this statement is not quite so foolish as it sounds to an engineer for this reason. At most of the institutions, the principal load on the boiler plant is the heating load, and for about seven or eight months in the year there is no exhaust steam wasted. For all practical purposes then, the only cost of the water during the seven or eight months of heating season is the wear and tear on the machinery. At most of these institutions, much of the common labor around the power plant is inmate labor. However, the wasteful habits acquired during the seven or eight months of the heating season are continued during the remainder of the year and then it costs coal.

There is another aspect of the problem to consider. As the institution grows, its pumping capacity must be increased or its per capita consumption reduced. If reasonable economy is practiced in the use of water, the demand can often be reduced to a point where the same pumping equipment which supplied the institution in the past will be ample for the enlarged institution. If the waste of water were permitted to continue, it would entail the purchase of additional pumps in order to supply this waste.

One of the most interesting cases of water waste, and perhaps one of the most difficult to locate and stop, was at the Pontiac State Reformatory. All of the water for the power house, the laundry and the domestic hot water supply was pumped from a spring-fed lake on the institution grounds. Water for all other purposes was purchased from the local utility company. No records were available of the amount of water pumped from the institution lake, but the water furnished by the local utility company was metered. The author was surprised to find that this institution used 220 gallons per capita per day, exclusive of the water used in the power house, the laundry and the domestic hot water system. An inspection of the plumbing showed it to be in apparently good condition. The meter was tested and found accurate within ordinary commercial limits. The leakage from underground mains was so small as to be practically negligible, in spite of the fact that much of the underground piping was wrought iron and steel, installed for years.

The institution was finally divided into sections, so far as the arrangement of mains would allow. A meter was placed on each

section and read hourly for twenty-four hours as well as the meter on the service main. In this way it was found that the cell houses were the trouble makers. Each cell has a lavatory with a single self-closing faucet and a closet, flushed by means of a self-closing cock. One of the cell houses showed a per capita consumption of 140 gallons per day, while the other showed a per capita consumption of 72 gallons per day. Carrying the investigation further, it was found that the inmates had learned that by turning the self-closing faucet wide open, they could balance it in this position and by a little rough usage, could burr the top of the tooth or bevel, giving the pin a better surface to rest upon and thus making it all the easier to balance it in this position.

On arising in the morning, all the inmates apparently washed in running water, for during the first hour after rising, 434 inmates in the north cell house used 5500 gallons of water or 12.6 gallons per inmate per hour. In the south cell house, 543 inmates used 37 gallons or slightly less than 7 gallons per inmate per hour. The north cell house housed the more unruly boys while the other cell house was occupied by the better behaved boys. The all-night consumption ran rather high, indicating that a number of the boys were letting their faucets run wide open, presumably to have cold water should they awake in the night and want a cold drink.

A modified design for the self-closing cocks was worked out, which consists essentially of a stop so arranged that the faucet or cock cannot be opened into the wide-open position. The bar handle has been replaced with a round, smooth disc, having a knurled edge.

At the Watertown State Hospital, a pumping station is nearing completion which promises to solve the water problem there for some time to come. A year and a half ago, this institution had a new pumping station, built over a reservoir or basin, with a single small well opening into the bottom of the basin. It was quite complete, except that there was practically no water to pump. The small well was useful only as a test well, giving a clue as to the depth at which water was obtainable, the height to which the water would rise and the quality of the water. Having obtained these data, two wells were drilled, one on each side of the pump house. Well 1 is 275 feet deep, while in the case of well 2, it was necessary to go down to a depth of 325 feet to get the same flow and kind of water. In drilling these two wells, not over 70 feet apart, different strata were encountered all the way down. In the

case of well 2, practically the same water was obtained at a depth of 325 feet as in well 1 at a depth of 275 feet, only the flow was about 75 gallons per minute less. As the well was in solid rock at that point, the author decided to dynamite the well. He exploded 60 pounds of 40 per cent dynamite at the bottom of the well and succeeded in increasing the flow to just a trifle more than the flow of well 1.

The water situation at Jacksonville affects the engineering department directly because there are three institutions in that city, all depending on the city water supply. For years the water service there has been subject to interruptions and was extremely unreliable. A year ago, there was danger of a complete shut down of the supply and, in fact, arrangements were under way to temporarily close the institutions and transfer the inmates to other institutions, when the snow melted and relieved the situation. During that time, conditions had become so bad that it was necessary to shut the water off the buildings during certain hours in the day, as there was not enough to keep the plumbing in operation 24 hours per day. Snow was dumped into the institution reservoir and in some instances snow was brought into the buildings, melted in the bath tubs and the water used for mopping up the floors. During this time an insane hospital, a school for blind children and a school for deaf children were practically without fire protection.

As might be expected, the institutions which get their water supply from wells have considerable trouble with scale in their boilers and scale in their domestic hot water heaters. The problem of overcoming scale in boilers is an old one and, after all, resolves itself merely into a little engineering judgment and sufficient funds to carry out the idea. The problem of the domestic hot water supply is somewhat different for the department is limited in the kind of treatment it can give the water. Most of these institutions were equipped with domestic hot water heaters of the closed type, containing small brass or copper tubes. In several instances the tubes were practically stopped up with scale. To keep these heaters in service at all required frequent cleaning and even then, after a few days, the formation of scale in the tubes was sufficient to decrease the capacity of the heaters enough to cut down the temperature of the hot water perceptibly. Experience with this type of heater convinced the department that it was a failure with the water conditions existing at certain of the institutions.

Standard open feed-water heaters have been substituted for them because they are easier to clean and even when cleaning is neglected for a long period, the heating capacity remains practically unaffected. Instead of the small circulating pump ordinarily used with closed heaters, it is necessary to use a larger pump, one with sufficient capacity to supply the entire hot water demand. A centrifugal pump lends itself very nicely to this work, for if an unusually heavy demand is suddenly made on the system, the pressure falls and the capacity of the pump is increased proportionately. Moreover, the lower pressure results in a somewhat reduced flow at each outlet which, while not objectionable, results in the aggregate in an appreciable reduction of the demand. The characteristics of the pump, therefore, aid in increasing the capacity and reducing the demand simultaneously and automatically.

Where the open heater is used, the circulating line is connected back into the top of the heater. Circulation in the system is maintained by slightly opening the valve in the circulating line and discharging a continuous small stream into the heater. The only serious objection to this plan is the possibility of getting oil from the exhaust steam in the heater, into the water but by using a good grade of cylinder oil and a good type of oil separator and by properly designing the piping system, the probability of trouble from this source is small. This plan has worked out very successfully in every instance.

A discussion of the institutional water supply problem would not be complete without a reference to fire fighting equipment. This equipment is totally inadequate. Most of the institutions have an elevated tank for their daily supply. This is kept well filled and is the first line of defense. When a fire is reported, the fire whistle is blown, the fire pump started and the tank then shut off, giving direct fire pressure on the mains. In some instances, there are separate fire mains, but usually fire pressure has to be put on the entire system.

Every institution makes some attempt at an organized fire department and some of them are quite efficient. There was recently a midnight fire at an institution, in which, within five minutes after the first alarm was telephoned to the night operator, the fire pumps were in full operation and three lines of hose were playing on the fire. Except in one instance, a year ago when a water main laid too near the surface had frozen and was useless, the fire fighting equip-

ment and organization has handled every alarm promptly and effectively. Fire fighting is always serious business and in an institution which houses several thousand insane people, who are totally incapable of protecting themselves and are, moreover, often behind locked doors, the question of fire protection is doubly important. When you take away a person's liberty and lock him up, whether he is sane or insane, you owe it to him to protect him against fire with every means at your disposal.

DISCUSSION

F. J. Postel: In reply to questions the author stated that automatic sprinklers are not used anywhere, but their introduction in the broom factory at one of the institutions for the blind has been brought up for consideration. If such a system is justified anywhere, it is where blind people are employed in a broom factory. At the Watertown Hospital pumping station, the strata through which the wells passed varied all the way down. It was necessary to case one well only 25 feet and the other well about 70 feet. Furthermore, water was encountered at different levels. The static water level in the 275-foot well stands at practically the same elevation as in the 325-foot well. It has not yet been practicable to operate the two wells simultaneously. Permanent connections which will permit this are now being made. When well 2 was pumped the water level in the test well fell slightly and the water level in well 1 was practically unaffected, although it possibly did fall just a little. The water level falls as the rate of pumping increases. The limit to which the test went was the maximum drop in water level which would permit pumping with a suction pump having its cylinders located where the cylinders of the permanent pumping equipment are located, i.e., about 10 feet below ground level. The static level comes practically up to the pump cylinders or within about 10 feet of the ground level. The water level in the test well, which is located between the two wells, drops appreciably when either of the large wells is pumped and pumping one well does not materially lower the water in the other well 70 feet away.

The test well is a 4-inch hole to a depth of about 160 or 170 feet, and decreases in size at that point or else is obstructed at that point. The author was able, however, to get a sounding weight past the obstruction to a depth of about 260 feet.

D. R. Gwinn: The speaker has in mind a city, which is not located in Illinois, where the fire protection equipment was out of order and could not be used. The condition was reported to the trustees, who, after some consideration, unanimously passed a resolution to the effect that the superintendent would be justified in having the necessary repairs made, in case there should be a fire.